

PERFORMANCE EVALUATION OF TRACTOR DRAWN

POTATO DIGGER CUM - ELEVATOR

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ABSTRACT

Potato is the major tuber crop grown in country. It is a rich source of carbohydrate, used all over the country. Potato is harvested when it attains the physiologic maturity. Potato harvesting is time consuming operation due to its various activity taken place at the same time. There is different equipment of harvesting the potato from the field. This equipment is tractor operated, animal drawn, or hand operated. Tractor operated potato digger cum elevator is mainly used for digging and exposing potato tubers simultaneously. The digger was found to perform very well under varying soil condition. A potato digger cum elevator was designed and constructed which is capable of digging potato with a minimum of injury working on the principle of digging and elevating the soil and potatoes simultaneously. It reduces 75% labour and 50% operating time compared to conventional method of manual digging with spades, kudali and khurpi. It also results in 4-5% reduction in harvesting losses. The tractor drawn potato digger elevator was found highly economical, time saving, reducing, labour charges with minimum damages.

KEYWORDS: Physiologic Maturity, Conventional Method, Potatoes Simultaneously

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INTRODUCTION

Potato harvesting is one of the most important operations has to be performed preciously to have a good potato production. It has a direct effect on the potato bruising. Bruising has an essential effect on potato marketing. The mechanical brushing could be happened when the tractors wheels roll on the potato rows during harvesting.

Solanum Tuberosum L., Potato derived from Spanish language "Patata" is an ancient cultivated crop of South America of 16th century when Spaniard arrived and has been considered as one of the oldest tuber crop brought under cultivation in all countries of the world. According to Hawke's, potato plant was taken to India by the British missionaries in the late 17th century and to China, a little earlier. Since then, potato is cultivated through the country as a vegetable crop. In India, potato is known by various names in different regions and in various languages, such as Alu in Bengali, potato in English, Aloo Batala in Gujarati, Aalu in Hindi, Urala Kizangu in Malayalam, Bilati Alu in Oria, Uruzhai Kilangu in Tamil, Bangaladumpa Aalugadda in Telugu etc. Potato is considered as one of the most important vegetables crops, supplying human with carbohydrate. It is classified as the first alternative of the grain crops to solve the shortage of food in some countries. Potato, an ancient crop of 16th century was found in South America when Spaniards arrived in the 16th century. Further many more wild species occurred in South America and more specifically in the Andes of Peru and Bolivia, from one or more of

which cultivated potato could have been derived. From the Spanish introduction, it was then spreader to the continental Europe and Asia. It was then spreaded to Ireland, Scotland, Wales and parts of Northern Europe and from one or more of the British sources to most of British overseas colonies, including what was later taken to U. S. A. from Scotland, the potato was said to have been taken to Italy, from where the samples were sent to botanists in many parts of Germany and Australia. In the mid-eighteenth century the potato from Scotland and possibly been taken to Norway then to Sweden and Denmark. According to Hawke potato plants have been taken to the India by the British missionaries in the late seventeenth century and then to China, a little earlier. It was grown in Japan by the late seventeenth century and in part of Africa and West Indies around the same period.

Nutritive Value and Composition of Potato

Potato is a non-fibrous, non-cereal vegetable crop of both sub-tropical and temperate regions. It occupies the largest area under any single vegetable crop in the world and produces more food content per unit area than cereals in a short time. In some respects, it excels cereals in nutritive value and palatability (Table A-1). Potato tuber chiefly comprises water (75%-80%), carbohydrates (16%-20%), crude protein (2.5%-3.0%), fat (0.1%) and 1% minerals like calcium, copper, iron, magnesium, phosphorus, potassium, vitamin B and C. According to Verma and Gopalan et al., potato can contribute energy of 97 kcal per 100 gm of edible portion with calcium (7.7 mg), copper (0.15 mg), iron (0.75 mg), magnesium (24.2 mg), phosphorus (40.3 mg), potassium (56.8 mg) and Vitamin C (14-25 mg) per 100 mg of fresh weight (Table 2). Potato is a low fat content vegetable with unsaturated fatty acid and with more energy and carbohydrates considered nutritionally superior over other vegetable crops, like brinjal, cauliflower, lady finger, cabbage, tomato and carrot. Because of all these, nutritionists recommend prudent combination of cereal and vegetables in human diet to meet the deficiency of protein, vitamin C, carbohydrate and calorie content.

Area Production and Yield of Potato

Globally, Potato is a commonly used vegetable in the country. With production of 40-42 million tonnes, India is the third largest producer of the crop globally. Although India's yield levels are lower than the crop yield per hectare in Germany and Netherlands, they are higher than in China and Russia and the global average, the first three being yield of USA (44.3 MT/ha), Netherland (43.6 MT/ha) and Germany (40.0 MT/ha). According to the agricultural outlook and situation analysis reports quarterly agricultural outlook report April-June 2012, potato is cultivated throughout the world but it is mainly concentrated in countries like China, France, Germany, India, Netherlands, Spain, Poland & USA (Table 3). Through the cultivation of potato spreaded throughout the country (Table 5), The top 10 potato producing states in the country account for about 97 per cent of production covering 90 per cent of total crop area. Out of these states, the bulk production is concentrated in Uttar Pradesh, West Bengal and Bihar account for about 78 per cent of India's total potato production. UP has a share of 33.12 per cent of India's production, followed by West Bengal (31.4) per cent and Bihar (13.56 per cent). In terms of yield West Bengal tops the list with 32.96 MT per hectare, followed by U.P. with 24.88 MT and Bihar 18.41 MT per hectare. Potato is harvested mainly between October to December and January to April. There is a gap of about four months: May to August when no harvesting is done in any of these states requiring cold storage facilities. Among the common improved potato varieties grown in India, Kufri Chandramukhi (large, Oval, white), Kufri Jyoti (large, Oval, white), kufri Lalima (medium, round, red) are commonly grown in Uttar Pradesh.

Potato is harvested when it attains the physiologic maturity. Harvesting is the complete recovery of potato tubers out of ridge and separating them from bulk of soil, roots stones, Haulms without causing excessive damage. For this

purpose, various harvesting methods, Such as manual digging of ridges with a narrow spade /fork/khurpi followed by manual Picking by a labor group, use of animal drawn potato digger followed by manual picking, and use of tractor drawn elevator digger followed by manual picking or collecting them in a container automatically are followed. Small to medium farmers are follow first two methods which is time consuming and labor intensive and require energy between 600-700 man-hr/ha. These methods provide maximum recovery and minimum damage. Mechanical harvesting of Potato using spinner digger or elevator is partial and selective and is followed by farmers having large land holding (more than 8 ha). Though these are faster method of harvesting than manual harvesting but costly result in excessive damage (10-16%) and loss. In a comparative study on potato harvesting systems, Shyam quoted maximum exposure of tubers by elevator digger (85.6%) followed by spinner digger (83.3%), tractor mounted two rows mechanical digger (74.8%) and animal drawn digger (52.5%). Performance of commonly used hand tools and machines for potato harvesting presented in table 7, indicate that tractor drawn elevator digger and spinner digger respectively required 145 man-hr/ha and 345 man-hr/ha of the engine required following manual harvesting but at the same time animal drawn potato digger cause minimum damage (2-3%) followed by hand digging, elevator digging (10-15%), highest being spinner digger (15-20%).

Commercially available tractor mounted elevator digger provide with elliptical agitator is used almost universally by potato growers in harvesting potato. Though this machine reduces the operation time and labor requirement, it deteriorates the quality of potato because of high percentage of damage. Damage is caused primarily due to the constructional parameters, such as rod spacing, jump sprocket for vertical oscillation, web steepness and due to operational parameters, like conveyer to forward speed ratio, peak acceleration and direction of agitator of elevator web. In the elevator digger, elevator web is agitated vertically with the help of elliptical sprocket to separate the potatoes from soil, soil clods and stones if any etc. The elliptical sprocket/ jump sprocket help in creating vertical oscillation of conveyer web which in turn produce vertical oscillation of soil potato mass and potatoes after separation, damage in tubers occurs. Because of irregular shape of potato, many of them impact with rods, side walls and soil clods and jump out of the conveyer web inserted windrowing them in a row. Potato jumping and damage become excessive when vertical oscillation is vigor. Extra labor is therefore, required for manual picking. It is, therefore, necessary to estimate the extent of damage and soil-potato separation by the potato elevator digger so as to suggest suitable modification and control of machine parameters to reduce tuber damage and improve soil-separation. There is different equipment of harvesting of potatoes from the field. This equipment may be tractor operated, animal drawn or hand operated etc. The tractor operated potato harvesters fall in four categories 1.Blade type Digger 2.Spinner Digger 3.Elevator Digger 4.Oscillating / Vibratory Digger The project work has been under taken to study the following To Evaluate performance of tractor drawn potato digger cum elevator. To Study the economics of different method of potato harvesting.

MATERIALS AND METHODS

The present research “Performance Evaluation of Tractor Drawn Potato Digger cum Elevator” was carried out at agronomical conditions of Allahabad (U.P.). All the treatment was carried out at the same time in different plots.

Table 1: Technical Program for Performance Evaluation of Tractor Drawn Potato Digger Com Elevator

Sr. No.	Treatment	Description
1.	T1	Harvesting with Tractor Drawn Potato Digger Elevator.
2.	T2	Harvesting with spades by manual digging
3.	T3	Harvesting with two row Potato digger

- **Plot Size (T):** 90 X 35 m²
- **Experimental Design:** RBD (Randomized Block Design)
- **Replication:** 4

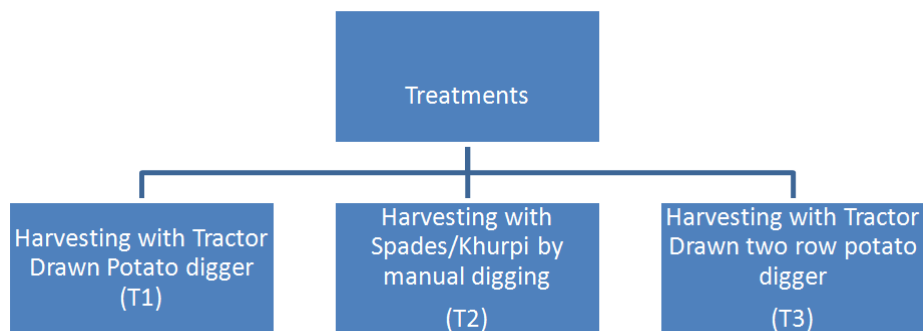


Figure 1

Experimental Layout

Table 1

	T1	T2	T3	T2	T1	T3
	Irrigation Channel					
	T3	T2	T1	T3	T2	T1

T1: Harvesting with Tractor Drawn Potato Elevator

T2: Harvesting with spades by Manual Digging.

T3: Harvesting with tractor drawn two rows Potato Digger



Plate: 1 Stationary View of Potato Digger Cum Elevator



Plate: 2 Exposed Potato Tubers after Harvesting by Potato Digger Cum Elevator

The constructional and functional details of the machine and procedure followed for the field testing and measurements are described below:

- Construction and working principle of machine
- Field condition and operation of machine
- Measurement of performance parameters.
- Cost of operation.

Field Condition and Operation of Machine

Field Condition

The performance evaluation of the implement was done at farm of Shuats, Allahabad (UP). The shape of the field for trial was rectangular having an area of about 3150 m². Planting of potatoes in this field was done manually. The height of the ridges was mm and the spacing between the rows was mm as shown in the figure 1. Field tests were conducted on the April – May 2016. The soil moisture was g/cm³ on dry basis which was adequate for digging operation as the soil did not stick to the potatoes. The variety of potato for which trial was conducted was.

For the comparison with other methods of potato harvesting, tests were conducted on.

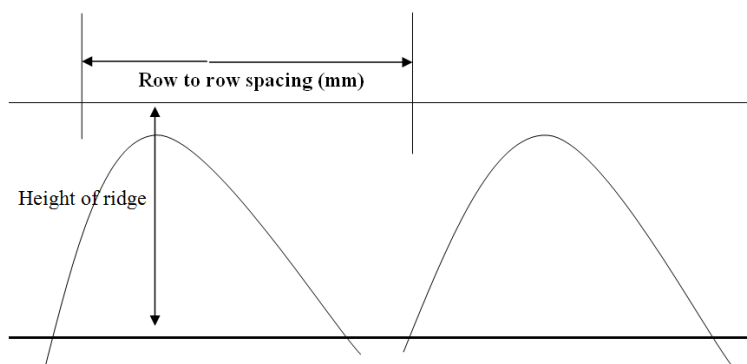


Figure 2: Showing spacing between the ridges and height of ridge

OPERATION OF THE MACHINE

The potato crop was ready for harvesting after 120days of planting. The harvesting operation was carried on the April-May 2013 by potato digger cum elevator machine mounted on M & M tractor. The test procedures are as follows:

- First of all the dimensions of the field where the test was to be conducted were measured and the area was calculated. The length was 56m and breadth was 35m. The area of the rectangular field was found to be sq-m.
- The height of the ridges and row to row spacing was measured before harvesting operation. The height of the ridges was mm and the spacing between the rows was mm.
- The field was divided into nine plots of equal dimension along the length. The area of each plot was approximately 90 x 35 m².
- Before harvesting operation the fuel tank of the tractor was topped up to the brim.

- The machine was initially adjusted to 50 mm depth and 1000 erpm. The amounts of exposed potatoes were picked up manually and their weight was recorded. Later on the potatoes which remained unexposed were dug with the help of khurpi and weighed. From the total amount of potatoes cut and bruised potatoes were separated and weighed properly. This process was repeated for 1200 and 1400 ERPM for the same depth.
- Then the depth was increased to 75 mm and digging of the potatoes by the implement was done at different rpm to evaluate the amount of exposed potatoes. The same was repeated with 100 mm depth of operation.
- Machine was designed as such to avoid covering the potatoes by the soil. Circuitous pattern of machine operation was adopted. In this operation, alternate pair of ridges was dug leaving beside the adjacent pair. This pattern was adopted to avoid the turning losses in the field.
- The total time recorded for harvesting operation was recorded with the help of a stop watch and subsequently fuel consumption in liters per hour was calculated by subtracting the amount of fuel left in the tank from the initial amount of fuel taken.

Independent Variable

Independent variables were those variables which were controlled by the operator. The independent variables which were taken are given below:

- **Speed:** 1000, 1200, 1400 rpm
- **Depth of Cut:** 50, 75, 100 mm

Dependent Variables

Dependent variables were those variables whose values were dependent on the independent variables. The dependent variables which were taken are given below:

- Digging efficiency in percent
- Separating index in percent
- Damage percentage
- Fuel consumption in l/h
- Field capacity

Depth of Cutting

The heights of ten ridges were measured randomly before the operation of the machine. The average height (h) of ridges was calculated from these readings. The average height (h) of ridges was calculated. After the operation of the machine, the remaining height (h₁) was measured at different places. The difference gave the depth of cut of the machine (figure 2).

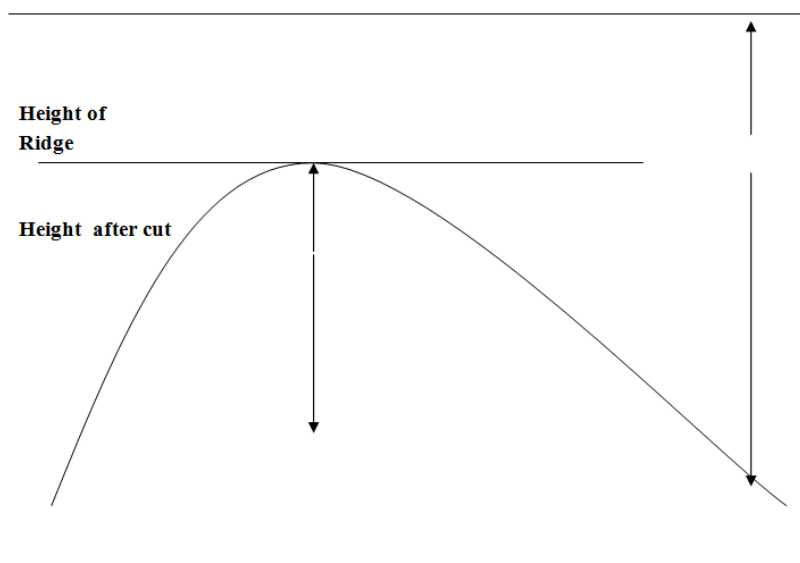


Figure 2: Showing the Method for Calculating Depth of Cut
 (Depth of cut = height of ridge – height after cut)

After each test run, a sample area was demarcated at three places randomly. The sampling area was thoroughly cleaned and the weight of potatoes, both exposed and covered with soil was recorded. The result was presented on percentage basis

Fuel Consumption

The fuel consumption was measured by Top-Up Method, in which the tractor was parked on a leveled ground near the test plot or field in the village before starting the actual test in order to check and measure the amount of field in the tank correctly. Diesel was filled up to the brim of the tank. While filling the diesel it was be stirred by a stick to remove the air bubbles from the tank. Total time of machine operation (T) in seconds and area covered (A) in square meter was recorded. After completing the testing operation the tractor was brought to the same leveled ground, positioned same as at the time of filling of tank. Measured amount of diesel thus filled in the tank and the amount of diesel filled was taken as the fuel consumption. Fuel consumption was calculated as given below:

Where;

L = Total fuel consumed (liters)

T = Total time taken (hours)

Cost of Operation

Cost of operation is an important factor to judge the performance of any machine over its counterpart machine and performing the same operation. The cost of operation for the two row potato digger was taken in order to see whether the machine proves to be economical for the farmers.

The following assumption was taken for calculating the cost of operation.

- Initial cost of digger = Rs 28,000
- Life of digger = 10 yrs

- No. of useful working hours = 300 hrs/year
- Rate of interest = 16% per annum (as prevalent in market)

Cost of Oil and Lubricants

Since different oils are available in the market, therefore it is taken as 15% of the fuel cost as suggested by Kepner et al (1987).

Repair and Maintenance Charges

As suggested by Kepner et al (1987), it was taken as 7% per year.

Labor Charges

Considering the working hours as 8 hrs per day, it was taken as follows:

Wages of operator = Rs.150/day

Wages of unskilled labor = Rs.80/day

Cost of potatoes = Rs.16/kg

Total Variable Cost = Fuel Cost + Lubrication Cost + Repair and Maintenance Charges + Labour Charges

Total Cost of Operation, Rs/hr = Total fixed cost + Variable cost

Total Cost of Operation, Rs/hr = Cost of operation, Rs/hr/effective field capacity, ha/hr

Cost of Operation for Manual Digging

It was surveyed that, conventional method (digging by desi plough and picking manually) requires days for digging, costing Rs.18520 and man-hr/ha for picking costing Rs.11200. Thus, for complete operation in conventional method, it costs Rs./ha.

RESULTS AND DISCUSSIONS

This chapter deals with the discussion of the results of laboratory investigation carried out on the experimental Potato elevator digger in comparison to two-row potato digger and manual digging with khurpi and spades.

The experiment on performance evaluation of tractor drawn potato digger cum Elevator was carried out during March - April, 2013 at the farm of Shuats. Harvesting of potato with tractor drawn potato digger cum elevator (T1), Harvesting with spades/ khurpi by manual digging (T2) and harvesting with two row potato digger (T3) is discussed in the following heads:

Quality of Potato Tubers

The digger was found to perform very well under varying soil condition. Very little mechanical injury of the tubers was observed of two types. These cut tubers and skinned tubers. The percentage of cut tubers damage was based on the total weight and no. of tubers in each sample. It is evident that with the increase in forward speed the skinning damage also increases up to 4%. On studying, the average percentage of slightly to severely damaged tubers was 3.2%. This is considerably lower than the damage level of the commercial harvesters. It results in 4-5 reduction in harvesting losses.

Performance of Potato Digger cum Elevator

Tractor drawn potato digger cum elevator is suitable for digging and exposing tubers. It saves 75% labour and operating time and 50% on cost of operation compared to conventional method of manual digging with spades or by two row potato digger. The forward speed of the digger can vary up to 3 km/hr. This is highly recommended to the potato grower and to custom hire service.

Cost of Operation

The tractor drawn potato digger elevator was found highly economical, time saving, reducing, labor charges with minimum damages.

The implement cost is approximate Rs.45, 000 and its cost of operation is about 1,800 Rs/ha as compare to 2,400 Rs. /ha by conventional methods and fuel consumption by the potato digger cum elevator is 3.5 lt/hr. as compare to 5.5 lt/hr by use of two row potato digger. The output and input cost calculation, net profit and ratio of output and input cost has been given in table 2

Table 2: Summary of Output and Input Cost of the Method of Potato Harvesting

Sr. No.	Treatment	Cost on Labour Rs/ha	Machine Charges Rs/ha	Harvesting Cost Rs/ha	Total Input Cost Rs/ha	Total Output Cost Rs/ha	Net Profit Rs/ha	Output Input Ratio
1.	Tractor Drawn Potato Digger Elevator (T1)	600	885	1450	35353	60160	24825	1.71
2.	Manual Harvesting By Khurpi/ Kudal (T2)	7000	1520	8520	42405	51776	9371	1.22
3.	Tractor Drawn Two row Potato Digger or Cultivator (T3)	1200	2300	3500	37385	47680	10295	1.28

Cost of Harvesting

The cost of harvesting (Rs/ha) in treatments T1 by the tractor drawn potato digger cum elevator was Rs.1450, in treatment T2 by khurpi/ kudal was Rs.8520 and in treatment T3 by tractor drawn two row potato digger was Rs.3500.

Tractor drawn potato digger cum elevator is suitable for digging and exposing tubers. It reduces 75% labour and 50% operating time compared to conventional method of manual digging with spades and khurpi. Thus we can conclude that harvesting of potato by the potato digger cum elevator is the most economical treatment among all three treatments as shown in figure 3.

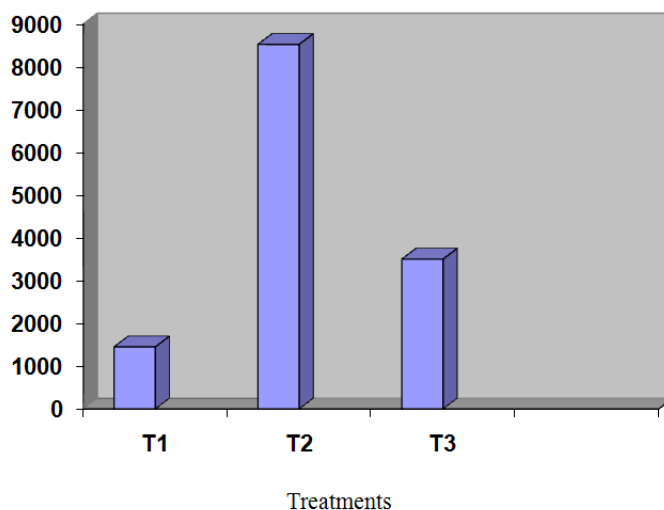


Figure 3: Cost of Harvesting of Potato (Rs/ha)

Economics of Machine

With a view of ascertain the economics of harvesting of potato using the potato digger cum elevator, the cost of harvesting under various harvesting treatment for potatoes was computed. The hourly cost of operation of potato digger cum elevator was lesser than other method of harvesting of potato.

The output input ratio in treatment T1 by the tractor drawn potato digger cum elevator was 1.71, in treatment T2 by the khurpi/ kudal was 1.22 and in treatment T3 by the tractor drawn two row potato digger or cultivator was 1.28. Thus we can conclude that the output input ratio was maximum by the tractor drawn potato digger cum elevator as shown in figure 4. The table 3 indicate that the output input ratio of different harvesting methods were 1.71, 1.22 and 1.24 with treatment T1, T2 and T3 respectively.

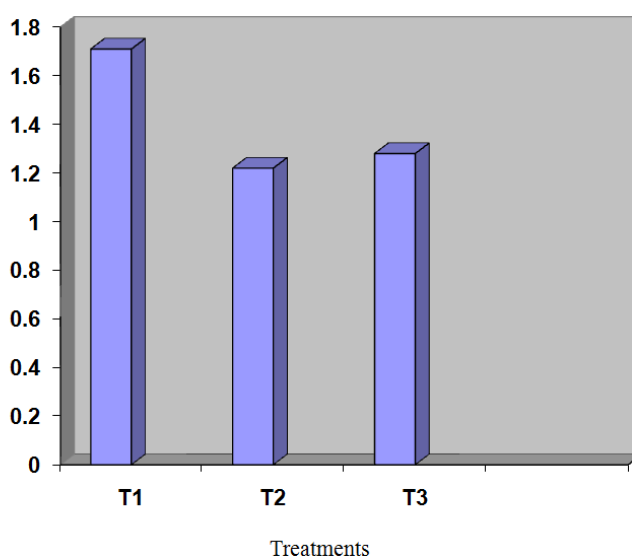


Figure 4: Output Input Ratio

Table 3: Comparative Performance of Different Method of Potato Harvesting

Sr. No.	Unit Operation	Method of harvesting		
		Manual Digging (Spade/Khurpi)	Tractor Drawn Two Row Potato Digger	Tractor Drawn Potato Digger Cum Elevator
1.	Equipment cost	NIL	6,000	35,000
2.	Output (ha/day)	0.01	2.0	1.4
3.	Digging	650	4	6
	a) Man – hr/ha			
3.	b) Tractor – hr/ha			
4.	Picking exposed Tubers (Man- ha/hr)	-	360	112
5.	Placing tubers in The sacks	40	40	40
6.	Total labor Required (Man- ha/hr)	690	420	174
7.	Bruising of Tubers (%)	2	1.5	1.5
8.	Cutting of tubers (%)	5	0.5	1.5
9.	Harvesting cost, Approx. (Rs/ha)	8520	3500	1450

Net Profit Shown by Machine Compared to Other Treatments

The data of the above table 3 shown that saving in cost of harvesting of potato by the tractor drawn potato digger cum elevator is less than other method of harvesting. The harvesting time can be saved by 10-15 days in tractor drawn potato digger cum elevator, which advance planting of summer vegetable crops. The highest loss of potato during harvesting was due to damage and covered potato in the soil, which cannot be used for marketing and storage. The above table shows the damage of potato due to machine or power source and losses due to covered potato in the soil. The figure 5 indicates that input cost other than harvesting equipment is maximum in case of tractor drawn potato digger cum elevator.

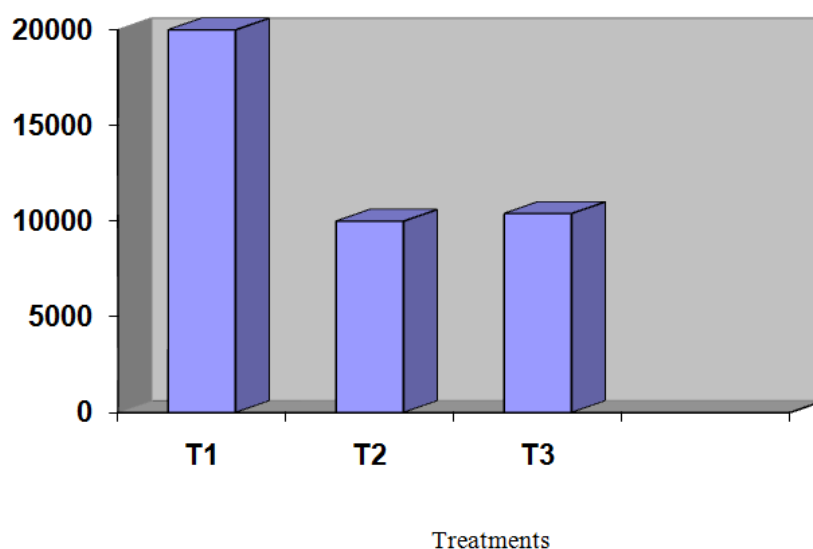


Figure 5: Net Profit (Rs/ha)

Moisture Content Measurement for Different Plots of the Field

Moisture content has been measured for different plots of the field by the Oven Dry method with the help of Core cutter and Oven. Three sample of soil for each plot were taken for moisture measurement and measured at dry basis. The corresponding values of moisture content % (db) was 17.81, 17.96, 17.84 and 17.90 in plots I, II, III, and IV respectively. The average value of moisture content % of the field was 17.88.

Table 4: Moisture Content for Different Plots of the Field

Sr. No.	Plots	Moisture Content %(db)
1.	I	17.81
2.	II	17.96
3.	III	17.84
4.	IV	17.90
Average		17.84

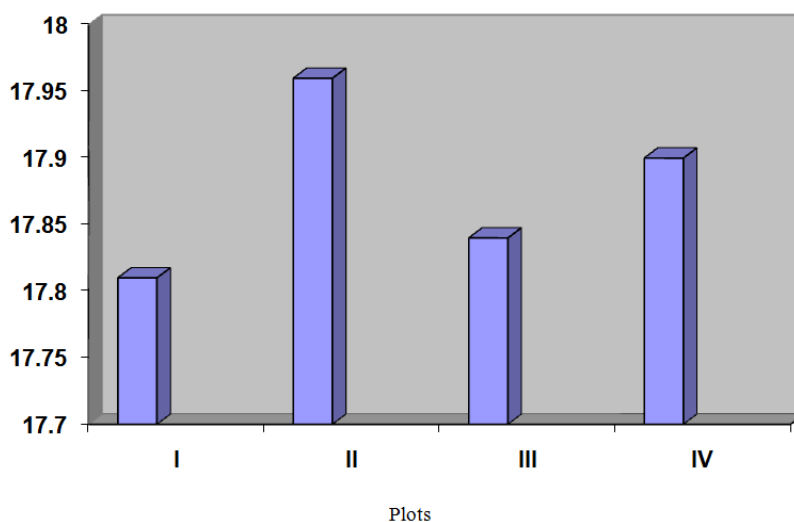


Figure 6: Moisture Content % (Db)

Test result of Potato Digger cum Elevator

Table 5

Suitable for	Potato
Actual field capacity	0.20-0.30 ha/hr
Tubers exposed	95-98 %
Bruising of tubers	1.5 (%)
Cutting of tubers	1.5 (%)
Damage	2 -3 %
Field efficiency	70-80%
Harvesting cost	1450 (Rs/ha)
Input output ratio	1.71
Net Profit	24,825 (Rs/ha)

SUMMARY AND CONCLUSIONS

Potato is vegetable crop of both sub-tropical and temperature region of the country. It occupies the largest area under any single vegetable crop in world and produces more food content per unit area than cereals in short span of time. Potato harvesting is time consuming operation due to its various activity taken place at the same time. The harvesting,

collection, bagging and transportation to the cold storage / stores operations are done simultaneously. Traditionally potato is harvested with Khurpi / spade/ kudali and is considered to be labor intensive and time – consuming process.

These operations require about 210 man-day per hectare when the crop is harvested manually with spade, khurpi or kudali. The field also become undulated when potato is harvested manually, and require 2-3 ploughing for next crop. The cost of production of potato become very high because of labor charges and also harvesting.

It requires more energy (600 man-ha/hr) than with animal drawn potato digger (400-425 man-ha/hr). On the contrary mechanical harvesters like spinner digger, elevator digger is the labor saving devices but at same time causes increased tuber damage and losses.

Commercially available tractor mounted potato digger cum elevator are common with farmers having 10 ha or more land. Potato damages like bruise, cut, split etc. are of the order 10-12 per cent in elevator diggers. Two pairs of elliptical sprockets that cause separation of potatoes from the soil, soil clods and foreign material, if any are responsible for damage. Therefore, it was felt essential to estimate the extent and type of damage, and soil-potato separation by the potato elevator digger.

A potato digger cum elevator was designed and constructed which is capable of diggings potatoes with a minimum injury, working on the principle of digging and elevating the soil and potatoes simultaneously. The digger, which is equipped with hydraulic drive, was found to be very flexible and could accommodate variable condition.

Tractor drawn potato digger elevator is suitable for digging and exposing tubers. It saves 75 percent labor and operating time and 50 percent cost of operation compared to conventional method of manual digging with spades or by cultivators. It also resulted in 4-5 % reduction in harvesting losses.

The following conclusion may be drawn based on the field trial of tractor drawn potato digger cum elevator.

- The potato digger cum elevator exposed 95-98 % of potatoes in single pass.
- The tractor drawn potato digger cum elevator was found highly economical, time saving, reducing labour dependency with minimum damage. This is highly recommended to the potato growers and to the custom higher services.
- The use of tractor drawn potato digger cum elevator is advantageous for harvesting potatoes in terms of cheapness, labour saving, saving in operational time and fuel (diesel) consumption on area basis. The total operational time and diesel consumption per unit area basis by minimum in case it saves 75 percent labour and operating time and 50 percent cost of operation compared to conventional method of manual digging with spades or by cultivators.
- The potato damage is about 2-2.5 % by use of digger cum elevator is comparatively lesser than by use of deshi plough (5.2%) and manual digging by spade and khurpi (4.5-7%). It results in 4-5% reduction in harvesting losses.
- The percentage of potato digger elevator does not require additional vertical force.
- The hourly cost of operation of tractor with tractor drawn potato digger cum elevator was comparatively higher than the other potato harvesting equipment. However the cost of operation on area basis was minimum.

- The maximum output – input ratio of 1.71 was observed in case of tractor drawn potato digger.
- The effective field capacity of machine was 0.3 ha/hr in first pass and 0.50 ha/hr in second pass.

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